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JCS64 U.S. PTO

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**NEW UTILITY PATENT APPLICATION
TRANSMITTAL
(Large Entity)**

(Only for new nonprovisional applications under 37 C.F.R. 1.53(b))

Docket No. S63.2-9397

Total Pages in this Submission

(including checks and postcard)

34

Box Patent Application
Commissioner for Patents
Washington, D.C. 20231

JCS64 U.S. PTO

09/666866



09/20/00

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled: IMPROVED LONGITUDINALLY FLEXIBLE EXPANDABLE STENT

and invented by: Brian J. Brown and Michael L. Davis

If a CONTINUATION APPLICATION, check appropriate box and supply the requisite information:

☒ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: 09/122,431 filed on July 24, 1998 which is a continuation of US Application No. 08/511,076, filed August 3, 1995 which is a continuation-in-part of US Application No. 08/396,569, filed March 1, 1995

Enclosed (in addition to the 4 pages of this transmittal) are:

5 pages

Application Elements

1. ☒ Filing fee as calculated below:

a. ☐ filing fee is NOT ENCLOSED - fee will be paid at the time of responding to the Notice of Missing Parts -- DO NOT CHARGE DEPOSIT ACCOUNT

b. ☐ a check in the amount of \$690.00 to cover the filing fee is enclosed.

___ pages

c. ☒ charge to Deposit Account as authorized at Item 2(a) on next page.

FEE CALCULATION AND CLAIMS

For	No. Filed	No. Allowed	No. Extra	Rate	Fee
Total Claims	19	- 20 =		x \$18.00	\$
Indep. Claims	3	- 3 =		x \$78.00	\$
BASIC FEE					\$690.00
TOTAL FILING FEE					\$690.00

<p align="center">NEW UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity)</p> <p align="center"><i>(Only for new nonprovisional applications under 37 C.F.R. 1.53(b))</i></p>	Docket No. S63.2-9397
	<p align="center">Total Pages in this Submission <i>(including checks and postcard)</i></p> <p align="center">34</p>

continued on next page.....

2. The Commissioner is hereby authorized to charge and credit Deposit Account No. 22-0350 as described below. A duplicate copy of this sheet is enclosed.

- a. ☒ Charge the amount of \$ 690.00 as filing fee.
- b. ☒ Credit any overpayment.
- c. ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- d. ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

☒ Specification having 2 pages and including the following: 9 pages

- a. ☒ Application Cover Sheet - 1 page
- b. ☒ Descriptive Title of the Invention -
- c. ☒ Cross References to Related Applications *(if applicable)*
- d. ☐ Statement Regarding Federally-sponsored Research/Development *(if applicable)*
- e. ☐ Reference to Microfiche Appendix *(if applicable)*
- f. ☒ Background of the Invention
- g. ☒ Brief Summary of the Invention
- h. ☒ Brief Description of the Drawings *(if applicable)*
- i. ☒ Detailed Description
- j. ☒ Claim(s) as Classified Below - 2 page
- k. ☒ Abstract of the Disclosure - 1 page

☒ Drawing(s) *(when necessary as prescribed by 35 U.S.C. 113)* 3 sheets 3 pages

5. ☒ Oath or Declaration - 4 pages

- a. ☐ Newly executed *(original or copy)* ☐ Unexecuted
- b. ☒ Copy from a prior application (37 C.F.R. 1.63(d)) *(for continuation/divisional application only)*

6. ☒ Separate Power of Attorney 1 page

- ☐ 37 C.F.R. 3.73(B) Statement *(when there is an assignee and power of attorney is from assignee)*. It is hereby certified that the undersigned has authority to make this certification and has reviewed all the documents in the chain of title of the patent application identified herein and, to the best of undersigned's knowledge and belief, title is in the assignee identified in the accompanying Power of Attorney.

NEW UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity) <i>(Only for new nonprovisional applications under 37 C.F.R. 1.53(b))</i>	Docket No. S63.2-9397
	Total Pages in this Submission <i>(including checks and postcard)</i> 34

☒ Power of Attorney filed in parent application.

7. ☒ Incorporation by Reference *(usable if Box 5b is checked)*

The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 5b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

8. ☐ Computer Program in Microfiche *(Appendix)* _____ pages

9. ☐ Nucleotide and/or Amino Acid Sequence Submission _____ pages
(if applicable, all must be included)

- a. ☐ Paper Copy
- b. ☐ Computer Readable Copy *(identical to computer copy)*
- c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

Accompanying Application Parts

10. ☒ Assignment Papers: _____ pages

- a. ☐ Assignment Recordation Cover Sheet (Form PTO 1595)
- b. ☐ Assignment
- c. ☐ A check in the amount of \$____ to cover the Recordal Fee
- d. ☒ Previously recorded on August 3, 1995, Reel 7632, Frames 0502 and 0503

11. ☐ English Translation Document *(if applicable)* _____ pages

12. ☐ Information Disclosure Statement: _____ pages

- a. ☐ PTO Form 1449
- b. ☐ Copies of IDS Citations

13. ☒ Preliminary Amendment 8 pages

14. ☒ Acknowledgement Postcard 1 page

15. ☒ Form of Mailing - Express Mail *(Specify Label No.):* EL599955821US

16. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)* _____ pages

NEW UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity) <i>(Only for new nonprovisional applications under 37 C.F.R. 1.53(b))</i>	Docket No. S63.2-9397
	Total Pages in this Submission <i>(including checks and postcard)</i> 34

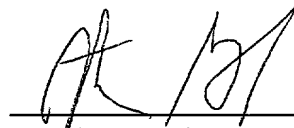
17. ☒ Additional Enclosures *(please identify below)*: 3 pages
- ☒ Constructive Petition for Extension of Time and Fee Authorization Pursuant to 37 C.F.R. §1.136(a)(3) - 1 page
 - ☒ Correspondence Address form - 1 page
 - ☒ Limited Authorization to Act on Behalf of Assignee Regarding Certain Patent Matters Effective Through: December 31, 2000 - 1 page

Respectfully submitted,

VIDAS, ARRETT & STEINKRAUS

Date: September 20, 2000

By:



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Brown et al.
Application No.:	Not assigned yet
Filed:	Concurrently herewith
For:	IMPROVED LONGITUDINALLY FLEXIBLE EXPANDABLE STENT
Examiner:	Not assigned yet
Group Art Unit:	Not assigned yet

Commissioner for Patents
Washington, D.C. 20231

Docket No.: S63.2-9397

PRELIMINARY AMENDMENT

Before calculating the filing fee and beginning examination of this application, please amend the application as follows:

In the Specification:

On page 1, please delete lines 3-4 and replace them with the following text:

--This application is a continuation of US Application No. 09/122,431 filed on July 24, 1998 which is a continuation of US Application No. 08/511,076, filed August 3, 1995 which is a continuation-in-part of US Application No. 08/396,569, filed March 1, 1995, the contents of all of which are incorporated herein in their entirety by reference.--

In the claims:

Please cancel claims 1-15.

Please add new claims 16-35 as follows:

--16.(New) A stent in a non-expanded state, comprising:

a first expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the first expansion strut pair that couples the first and second expansion struts at a distal end of the first expansion strut pair, a plurality of the first expansion strut pair forming a first expansion column;

a second expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the second expansion strut pair that couples the first and second expansion struts of the second expansion strut pair at a proximal end of the second expansion strut pair, a plurality of the second expansion strut pair forming a second expansion column;

a first connecting strut including a first connecting strut proximal section and a first connecting strut distal section, the first connecting strut proximal section being coupled to the distal end of the first expansion strut pair in the first expansion column and the first connecting strut distal section being coupled to the proximal end of the second expansion strut pair of the second expansion column, a plurality of the first connecting strut forming a first connecting strut column that couples the first expansion column to the second expansion column;

a third expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a third joining strut of the third expansion strut pair that couples the first and second expansion struts at a proximal end of the third expansion strut pair, a plurality of the third expansion strut pair forming a third expansion column;

a second connecting strut including a second connecting strut proximal section and a second connecting strut distal section, the second connecting strut proximal section being coupled to the distal end of the second expansion strut pair in the second expansion column, the second connecting strut distal section being coupled to the proximal end of the third expansion strut pair of the third expansion column, a plurality of the second connecting strut forming a second connecting strut column that couples the second expansion column to the third expansion column; and

wherein the first expansion strut of the first expansion strut pair in the first expansion column has a longitudinal axis offset from a longitudinal axis of the first expansion strut of the second expansion strut pair in the second expansion column.

17.(New) The stent of claim 16, wherein the second expansion strut of the third expansion strut pair in the third expansion column has a longitudinal axis that is offset from a longitudinal axis of the first expansion strut of the second expansion strut pair of the second expansion

column.

18.(New) The stent of claim 16, wherein the first and second expansion columns are each unbroken, continuous structures.

19.(New) The stent of claim 16, wherein at least a portion of the first connecting struts have first linear sections coupled to joining struts of first expansion strut pairs and second linear sections coupled to joining struts of second expansion strut pairs.

20.(New) The stent of claim 16, wherein at least a portion of the first connecting struts have first linear sections coupled to joining struts of first expansion strut pairs, second linear sections coupled to joining struts of second expansion strut pairs and third linear sections coupling the first and second linear sections.

21.(New) The stent of claim 16, wherein at least a portion of the first connecting struts have first linear sections coupled to joining struts of first expansion strut pairs, second linear sections coupled to joining struts of second expansion strut pairs, third and fourth linear sections coupling the first and second linear sections.

22.(New) The stent of claim 16, wherein at least a portion of the first connecting struts have first linear sections coupled to joining struts of first expansion strut pairs, second linear sections coupled to joining struts of second expansion strut pairs, third and fourth linear sections coupling the first and second linear sections.

23.(New) The stent of claim 16, wherein the first expansion strut of the first expansion strut pair in the first expansion column and the second expansion strut of the third expansion strut pair in the third expansion column have the same longitudinal axis.

24.(New) The stent of claim 16, wherein the second expansion strut of the first expansion pair in the first expansion column and the first expansion strut of the second expansion pair in the second expansion column have the same longitudinal axis.

25.(New) The stent of claim 16 wherein the longitudinal axis of the first expansion strut of the first expansion strut pair in the first expansion column has a longitudinal axis offset from a longitudinal axis of the first expansion strut of the second expansion strut pair in the second expansion column.

26.(New) A stent in a non-expanded state, comprising:

a first expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the first expansion strut pair that couples the first and second expansion struts at a distal end of the first expansion strut pair, a plurality of the first expansion strut pair forming a first expansion column;

a second expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the second expansion strut pair that couples the first and second expansion struts of the second expansion strut pair at a proximal end of the second expansion strut pair, a plurality of the second expansion strut pair forming a second expansion column;

a first connecting strut including a first connecting strut proximal head section and a first connecting strut distal tail section, the head section being coupled to the distal end of the first expansion strut pair in the first expansion column and the tail section being coupled to the proximal end of the second expansion strut pair of the second expansion column, a plurality of the first connecting strut forming a first connecting strut column that couples the first expansion column to the second expansion column;

a third expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a third joining strut of the third expansion strut pair that couples the first and second expansion struts at a proximal end of the third expansion strut pair, a plurality of the third expansion strut pair forming a third expansion column, the first expansion strut of the first expansion strut pair in the first expansion column having a longitudinal axis that is parallel to and offset from a longitudinal axis of the first expansion strut of the second expansion strut pair in the second expansion column, and the second expansion strut of the third expansion strut pair in the third expansion column has a longitudinal axis that is parallel to and offset from a longitudinal axis of first expansion strut of the second expansion strut pair of the second expansion column, a plurality of the third expansion strut pair forming a third expansion column;

a second connecting strut including a proximal head section and a distal tail section, the head section being coupled to the distal end of the second expansion strut pair in the second

expansion column and the tail section being coupled to the proximal end of the third expansion strut pair of the third expansion column, a plurality of the second connecting strut forming a second connecting strut column that couples the second expansion column to the third expansion column, and

wherein a ratio of a number of expansion struts to a number of connecting struts is selected to provide a sufficient stent flexibility to permit introduction of the stent through a selected blood vessel.

27.(New) The stent of claim 26 wherein the first and second expansion columns are each unbroken, continuous structures.

28.(New) The stent of claim 26, wherein a width of a portion of the second expansion struts is substantially the same as a width of a portion of the first expansion struts.

29.(New) The stent of claim 26, wherein at least a portion of the first connecting struts have first linear sections coupled to joining struts of first expansion strut pairs and second linear sections coupled to joining struts of second expansion strut pairs.

30.(New) The stent of claim 26, wherein at least a portion of the first connecting struts have first linear sections coupled to joining struts of first expansion strut pairs, second linear sections coupled to joining struts of second expansion strut pairs and third linear sections coupling the first and second linear sections.

31.(New) The stent of claim 26, wherein at least a portion of the first connecting struts have first linear sections coupled to joining struts of first expansion strut pairs, second linear sections coupled to joining struts of second expansion strut pairs and third and fourth linear sections coupling the first and second linear sections.

32.(New) The stent of claim 26, wherein the first expansion strut of the first expansion strut pair and the second expansion strut of the third expansion strut pair have the same longitudinal axis.

33.(New) The stent of claim 26, wherein the first expansion strut of the first expansion strut pair in the first expansion column and the second expansion strut of the third expansion strut pair in the third expansion column have the same longitudinal axis.

34.(New) A stent in a non-expanded state, comprising:

a first expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the first expansion strut pair that couples the first and second expansion struts at a distal end of the first expansion strut pair, a plurality of the first expansion strut pair forming a first expansion column;

a second expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the second expansion strut pair that couples the first and second expansion struts of the second expansion strut pair at a proximal end of the second expansion strut pair, a plurality of the second expansion strut pair forming a second expansion column;

a first connecting strut including a first connecting strut proximal section, a first connecting strut distal section and a first connecting strut intermediate section, the first connecting strut proximal section being coupled to the distal end of the first expansion strut pair in the first expansion column and the first connecting strut distal section being coupled to the proximal end of the second expansion strut pair of the second expansion column, a plurality of the first connecting strut forming a first connecting strut column that couples the first expansion column to the second expansion column,

the first connecting strut being non-parallel to the first expansion strut of the first expansion pair and the second expansion strut of the first expansion strut pair.

35.(New) The stent of claim 34 wherein the first expansion strut of the first expansion strut pair in the first expansion column has a longitudinal axis offset from a longitudinal axis of the first expansion strut of the second expansion strut pair in the second expansion column.--

REMARKS

Claims 1-15 which are being prosecuted in a parent application have been canceled from the instant application without prejudice or disclaimer and new claims 16-35 have been added. Support for new claims 16-35 is found in Fig. 1 of the application as filed. Fig. 1 is

present in all of the priority applications as filed and hence is entitled to the earliest priority date claimed. Additional support may be found elsewhere in the application.

In accordance with 37 CFR 1.607(c), Applicant notes that many of the above claims correspond substantially to claims from US 5,954,743 to Jang, issued September 21, 1999. A table indicating the correspondence is provided below.

<u>Claim in instant application</u>	<u>Claim in Jang</u>
16	1
17	2
18	10
19	18
20	19
21	20
22	21
23	23
24	24
25	51
26	27
27	54
28	59
29	64
30	65
31	66
32	69
33	71

Appl. No.: Not yet assigned
Page 8

PRELIMINARY AMENDMENT

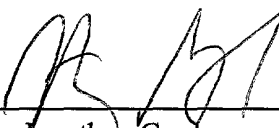
Applicant notes, however, that the correspondence identified above is not intended to constitute a statement that the scope of the claims is identical.

Respectfully submitted,

VIDAS, ARRETT & STEINKRAUS

Date: September 20, 2000

By: _____


Jonathan Grad

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DOCKET NO. S63.2-9397

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT**

INVENTOR(S): Brian J. Brown and Michael L. Davis

TITLE: IMPROVED LONGITUDINALLY FLEXIBLE EXPANDABLE
STENT

ATTORNEYS: Jonathan Grad
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IMPROVED LONGITUDINALLY FLEXIBLE EXPANDABLE STENT

This application is a Continuation of application Serial No. 08/396,569, filed March 1, 1995, the disclosure of which is hereby incorporated by reference.

5 Field of the Invention

This invention relates to an endoprosthesis device for implantation within a body vessel, typically a blood vessel. More specifically, it relates to a tubular expandable stent of improved longitudinal flexibility.

10 Background of the Invention

Stents are placed or implanted within a blood vessel for treating stenoses, strictures or aneurysms therein. They are implanted to reinforce collapsing, partially occluded, weakened, or dilated sections of a blood vessel. They have also been implanted in the urinary tract and in bile ducts.

15 Typically, a stent will have an unexpanded (closed) diameter for placement and an expanded (opened) diameter after placement in the vessel or the duct. Some stents are self-expanding and some are expanded mechanically with radial outward force from within the stent, as by inflation of a balloon.

An example of the latter type is shown in U.S. Patent No. 4,733,665 to
20 Palmaz, which issued March 29, 1988, and discloses a number of stent configurations for implantation with the aid of a catheter. The catheter includes an arrangement wherein a balloon inside the stent is inflated to expand the stent by plastically deforming it, after positioning it within a blood vessel.

A type of self-expanding stent is described in U.S. Patent No.
25 4,503,569 to Dotter which issued March 12, 1985, and discloses a shape memory stent which expands to an implanted configuration with a change in temperature. Other types of self-expanding stents not made of shape memory material are also known.

This invention is directed to stents of all these types when configured so
30 as to be longitudinally flexible as described in detail hereinbelow. Flexibility is a desirable feature in a stent so as to conform to bends in a vessel. Such stents are known in the prior art. Examples are shown in U.S. Patent No. 4,856,516 to

EL599955821US

Hillstead; U.S. Patent No. 5,104,404 to Wolff; U.S. Patent No. 4,994,071 to MacGregor; U.S. Patent No. 5,102,417 to Palmaz; U.S. Patent No. 5,195,984 to Schatz; U.S. Patent No. 5,135,536 to Hillstead; U.S. Patent 5,354,309 to Shepp-Pesch et al.; EPO Patent Application 0 540 290 A2 to Lau; EPO Patent Application
5 No. 0 364 787 B1 to Schatz, and PCT Application WO 94/17754 (also identified as German Patent Application 43 03 181).

Generally speaking, these kinds of stents are articulated and are usually formed of a plurality of aligned, expandable, relatively inflexible, circular segments which are interconnected by flexible elements to form a generally tubular body which
10 is capable of a degree of articulation or bending. Unfortunately, a problem with such stents is that binding, overlapping or interference can occur between adjacent segments on the inside of a bend due to the segments moving toward each other and into contact or on the outside of a bend the segments can move away from each other, leaving large gaps. This can lead to improper vessel support, vessel trauma, flow
15 disturbance, kinking, balloon burst during expansion, and difficult recross for devices to be installed through already implanted devices and to unsupported regions of vessel.

A diamond configuration with diagonal connections between each and every diamond of each segment is also known but such closed configurations lack
20 flexibility.

It is an object of this invention to provide a longitudinally flexible stent of open configuration that avoids these problems and exhibits improved flexibility (radially and longitudinally) in the stent body segments thereof rather than in flexible joints between the segments.
25

Summary of the Invention

To this end, the invention provides a tubular expandable stent, comprising: a plurality of cylindrical shaped open cylindrical segments aligned on a common longitudinal axis to define a generally tubular stent body, each segment
30 being defined by a member formed in an undulating flexible pattern of interconnected substantially parallel struts with pairs thereof having alternating interconnecting end portions to define the periphery of the expandable stent segment, and in which the connected end portions of paired struts in each segment, before the

stent is expanded, are positioned substantially opposite to connected end portions of paired struts in adjacent segments. The segments are interconnected by a plurality of interconnecting elements extending from some of the connected end portions on one segment to some of the connected end portions on adjacent segments in such a manner that there are three or more legs between points of connection from one side of each segment to its other side. Additionally, the connecting elements extend angularly from connecting end portion of one segment to connecting end portion of an adjacent segment, not to an opposite connecting end portion on an adjacent segment, whereby upon expansion of the stent the adjacent segments are displaced relative to each other about the periphery of the stent body to accommodate flexing of the stent within paired struts without interference between adjacent segments, rather than by means of articulating flexible connectors between segments. As a result, the connectors between the segments are not intended to flex or bend under normal use.

Brief Description of the Figures

Figure 1 shows a flat view of an unexpanded stent configuration according to the invention.

Figure 2 shows the pattern of Figure 1 in a tubular, unexpanded stent.

Figure 3 shows an expanded stent of the configuration shown in Figure

1.

Figure 4 shows a flat view of an alternate unexpanded stent configuration according to the invention.

Best Mode Description of the Invention

Turning to the Figures, Figure 1 and Figure 2 show a fragmentary flat view of an unexpanded stent configuration and the actual tubular stent (unexpanded), respectively. That is, the stent is shown for clarity in Figure 1 in the flat and may be made from a flat pattern 10 (Figure 1) which is formed into a tubular shape by rolling the pattern so as to bring edges 12 and 14 together (Figure 1). The edges may then be joined as by welding or the like to provide a configuration such as that shown in Figure 2.

The configuration can be seen in these Figures to be made up of a plurality of adjacent segments generally indicated at 16, each of which is formed in an undulating flexible pattern of substantially parallel struts 18. Pairs of struts are interconnected at alternating end portions 19a and 19b. As is seen in Figure 1, the
5 interconnecting end portions 19b of one segment are positioned opposite interconnecting end portions 19a of adjacent segments. The end portions as shown are generally elliptical but may be rounded or square or pointed or the like. Any configuration of end portions is acceptable so long as it provides an undulating pattern, as shown. When the flat form 10 is formed into an unexpanded tube as
10 shown in Figure 2, the segments are cylindrical but the end portions 19 of adjacent segments remain in an opposed position relative to each other.

A more preferred method of manufacture begins with a thin walled tube which is then laser cut to provide the desired configuration. It may also be chemically etched or EDM'd (electrical discharge machined) to form an appropriate
15 configuration.

Interconnecting elements 20 extend from one end portion 19 of one segment 16 to another end portion 19 of another adjacent segment 16 but not to an oppositely positioned end portion 19 of an adjacent segment 16. There are at least three struts included between the points on each side of a segment 16 at which an
20 interconnecting element 20 contacts an end portion 19. This results in the interconnecting elements 20 extending in an angular direction between segments around the periphery of the tubular stent. Interconnecting elements 20 are preferably of the same length but may vary from one segment to the other. Also, the diagonal direction may reverse from one segment to another extending upwardly in one case
25 and downwardly in another, although all connecting elements between any pair of segments are substantially parallel. Figure 1, for example shows them extending downwardly, right to left. Upwardly would extend up left to right in this configuration.

As a result of this angular extension of the interconnecting elements 20
30 between adjacent segments and loops, upon expansion of the stent as seen in Figure 3, the closest adjacent end portions 19 between segments 16 are displaced from each other and are no longer opposite each other so as to minimize the possibility of binding or overlapping between segments, i.e., pinching.

The number of interconnecting elements 20 may vary depending on circumstances in any particular instance. Three per segment are satisfactory for the configuration shown and at least three will be used typically.

5 The alternate design shown in Figure 4 includes longer struts 18a in the two end segments 16a than in the intermediate segments 16. This allows the end segments (16a) to have less compression resistance than the intermediate segments (16), providing a more gradual transition from the native vessel to the support structure of the stent. Otherwise, the configuration is the same as that shown in Figure 1.

10 As already indicated, this invention is applicable to self-expanding configurations, mechanically expandable configurations and to a wide variety of materials, including both metal and plastic and any other material capable of functioning as an expandable stent. For example, the stent may be of metal wire or ribbon such as tantalum, stainless steel or the like. It may be thin-walled. It may be
15 of shape memory alloy such as Nitinol or the like, etc.

The above Examples and disclosure are intended to be illustrative and not exhaustive. These examples and description will suggest many variations and alternatives to one of ordinary skill in this art. All these alternatives and variations are intended to be included within the scope of the attached claims. Those familiar
20 with the art may recognize other equivalents to the specific embodiments described herein which equivalents are also intended to be encompassed by the claims attached hereto.

What is claimed is as follows:

1. A tubular, flexible, expandable stent having a longitudinal axis, comprising:
a plurality of cylindrical shaped segments, the segment being defined by
a member formed in an undulating pattern of interconnected paired struts and in which
5 adjacent pairs of struts in a given segment are interconnected at opposite ends, the
interconnected ends defining end portions of the paired struts,
the segments aligned on a common longitudinal axis to define a generally
tubular stent body, and adjacent segments connected by a plurality of interconnecting
elements having first and second ends, each interconnecting element extending from an
10 end portion of paired struts on a segment to an end portion of paired struts on an
adjacent segment, the first end of each given interconnecting element displaced
circumferentially from the second end of the given interconnecting element.
2. The stent of claim 1 wherein the first end of each interconnecting element is
longitudinally displaced from the second end of each interconnecting element.
- 15 3. The stent of claim 1 wherein the interconnecting elements are formed of a non-
flexing material.
4. The stent of claim 1 wherein the orientation of the interconnecting elements
reverses between adjacent pairs of adjacent segments along the length of the stent.
5. The stent of claim 1 wherein the interconnecting elements between adjacent
20 segments are of the same length.
6. The stent of claim 1 wherein the interconnecting elements extend at an oblique
angle relative to the longitudinal axis of the stent.
7. The stent of claim 1 wherein the stent includes end segments and intermediate
segments and the end segments of the stent include longer struts than the intermediate
25 segments of the stent.
8. The stent of claim 7 wherein the orientation of the interconnecting elements
reverses between adjacent pairs of adjacent segments along the length of the stent.
9. The stent of claim 1 wherein the material of which it is comprised is metal.
10. The stent of claim 9 wherein the metal is a shape memory alloy.
- 30 11. The stent of claim 9 wherein the stent is a thin-walled tubular member.
12. The stent of claim 1 in a self-expanding configuration.
13. The stent of claim 1 in a mechanically expandable configuration.
14. A tubular, flexible, expandable stent having a longitudinal axis, comprising:

a plurality of cylindrical shaped segments, the segment being defined by a member formed in an undulating pattern of interconnected paired struts and in which adjacent pairs of struts in a given segment are interconnected at opposite ends, the interconnected ends defining end portions of the paired struts,

5 the segments aligned on a common longitudinal axis to define a generally tubular stent body, and adjacent segments connected by a plurality of interconnecting elements having first and second ends, each interconnecting element extending angularly from an end portion of paired struts on a segment to an end portion of paired struts on an adjacent segment, the first end of each given interconnecting element

10 displaced circumferentially from the second end of the given interconnecting element.

15. A tubular, flexible, expandable stent having a longitudinal axis, comprising:

a plurality of cylindrical shaped segments, the segment being defined by a member formed in an undulating pattern of interconnected paired struts and in which adjacent pairs of struts in a given segment are interconnected at opposite ends, the

15 interconnected ends defining end portions of the paired struts,

the segments aligned on a common longitudinal axis to define a generally tubular stent body, and adjacent segments connected by a plurality of interconnecting elements having first and second ends, each interconnecting element extending from an end portion of paired struts on a segment to an end portion of paired struts on an

20 adjacent segment, the first end of each given interconnecting element displaced circumferentially from the second end of the given interconnecting element, the orientation of the interconnecting elements reversed between adjacent pairs of adjacent segments along the length of the stent.

5 Segmented articlatable stent of open structure comprised of end-connected struts making up the segments with angular interconnects between segments.

10

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains. The *Agrobacterium* strains were cultured in YEA medium for 24 h at 28 °C. The cell concentration of the strains was adjusted to 1.0 × 10⁸ cells/ml. The cell suspension was then diluted to 10⁻¹, 10⁻², 10⁻³, 10⁻⁴, 10⁻⁵, 10⁻⁶, 10⁻⁷, 10⁻⁸, 10⁻⁹, 10⁻¹⁰, 10⁻¹¹, 10⁻¹², 10⁻¹³, 10⁻¹⁴, 10⁻¹⁵, 10⁻¹⁶, 10⁻¹⁷, 10⁻¹⁸, 10⁻¹⁹, 10⁻²⁰, 10⁻²¹, 10⁻²², 10⁻²³, 10⁻²⁴, 10⁻²⁵, 10⁻²⁶, 10⁻²⁷, 10⁻²⁸, 10⁻²⁹, 10⁻³⁰, 10⁻³¹, 10⁻³², 10⁻³³, 10⁻³⁴, 10⁻³⁵, 10⁻³⁶, 10⁻³⁷, 10⁻³⁸, 10⁻³⁹, 10⁻⁴⁰, 10⁻⁴¹, 10⁻⁴², 10⁻⁴³, 10⁻⁴⁴, 10⁻⁴⁵, 10⁻⁴⁶, 10⁻⁴⁷, 10⁻⁴⁸, 10⁻⁴⁹, 10⁻⁵⁰, 10⁻⁵¹, 10⁻⁵², 10⁻⁵³, 10⁻⁵⁴, 10⁻⁵⁵, 10⁻⁵⁶, 10⁻⁵⁷, 10⁻⁵⁸, 10⁻⁵⁹, 10⁻⁶⁰, 10⁻⁶¹, 10⁻⁶², 10⁻⁶³, 10⁻⁶⁴, 10⁻⁶⁵, 10⁻⁶⁶, 10⁻⁶⁷, 10⁻⁶⁸, 10⁻⁶⁹, 10⁻⁷⁰, 10⁻⁷¹, 10⁻⁷², 10⁻⁷³, 10⁻⁷⁴, 10⁻⁷⁵, 10⁻⁷⁶, 10⁻⁷⁷, 10⁻⁷⁸, 10⁻⁷⁹, 10⁻⁸⁰, 10⁻⁸¹, 10⁻⁸², 10⁻⁸³, 10⁻⁸⁴, 10⁻⁸⁵, 10⁻⁸⁶, 10⁻⁸⁷, 10⁻⁸⁸, 10⁻⁸⁹, 10⁻⁹⁰, 10⁻⁹¹, 10⁻⁹², 10⁻⁹³, 10⁻⁹⁴, 10⁻⁹⁵, 10⁻⁹⁶, 10⁻⁹⁷, 10⁻⁹⁸, 10⁻⁹⁹, 10⁻¹⁰⁰, 10⁻¹⁰¹, 10⁻¹⁰², 10⁻¹⁰³, 10⁻¹⁰⁴, 10⁻¹⁰⁵, 10⁻¹⁰⁶, 10⁻¹⁰⁷, 10⁻¹⁰⁸, 10⁻¹⁰⁹, 10⁻¹¹⁰, 10⁻¹¹¹, 10⁻¹¹², 10⁻¹¹³, 10⁻¹¹⁴, 10⁻¹¹⁵, 10⁻¹¹⁶, 10⁻¹¹⁷, 10⁻¹¹⁸, 10⁻¹¹⁹, 10⁻¹²⁰, 10⁻¹²¹, 10⁻¹²², 10⁻¹²³, 10⁻¹²⁴, 10⁻¹²⁵, 10⁻¹²⁶, 10⁻¹²⁷, 10⁻¹²⁸, 10⁻¹²⁹, 10⁻¹³⁰, 10⁻¹³¹, 10⁻¹³², 10⁻¹³³, 10⁻¹³⁴, 10⁻¹³⁵, 10⁻¹³⁶, 10⁻¹³⁷, 10⁻¹³⁸, 10⁻¹³⁹, 10⁻¹⁴⁰, 10⁻¹⁴¹, 10⁻¹⁴², 10⁻¹⁴³, 10⁻¹⁴⁴, 10⁻¹⁴⁵, 10⁻¹⁴⁶, 10⁻¹⁴⁷, 10⁻¹⁴⁸, 10⁻¹⁴⁹, 10⁻¹⁵⁰, 10⁻¹⁵¹, 10⁻¹⁵², 10⁻¹⁵³, 10⁻¹⁵⁴, 10⁻¹⁵⁵, 10⁻¹⁵⁶, 10⁻¹⁵⁷, 10⁻¹⁵⁸, 10⁻¹⁵⁹, 10⁻¹⁶⁰, 10⁻¹⁶¹, 10⁻¹⁶², 10⁻¹⁶³, 10⁻¹⁶⁴, 10⁻¹⁶⁵, 10⁻¹⁶⁶, 10⁻¹⁶⁷, 10⁻¹⁶⁸, 10⁻¹⁶⁹, 10⁻¹⁷⁰, 10⁻¹⁷¹, 10⁻¹⁷², 10⁻¹⁷³, 10⁻¹⁷⁴, 10⁻¹⁷⁵, 10⁻¹⁷⁶, 10⁻¹⁷⁷, 10⁻¹⁷⁸, 10⁻¹⁷⁹, 10⁻¹⁸⁰, 10⁻¹⁸¹, 10⁻¹⁸², 10⁻¹⁸³, 10⁻¹⁸⁴, 10⁻¹⁸⁵, 10⁻¹⁸⁶, 10⁻¹⁸⁷, 10⁻¹⁸⁸, 10⁻¹⁸⁹, 10⁻¹⁹⁰, 10⁻¹⁹¹, 10⁻¹⁹², 10⁻¹⁹³, 10⁻¹⁹⁴, 10⁻¹⁹⁵, 10⁻¹⁹⁶, 10⁻¹⁹⁷, 10⁻¹⁹⁸, 10⁻¹⁹⁹, 10⁻²⁰⁰, 10⁻²⁰¹, 10⁻²⁰², 10⁻²⁰³, 10⁻²⁰⁴, 10⁻²⁰⁵, 10⁻²⁰⁶, 10⁻²⁰⁷, 10⁻²⁰⁸, 10⁻²⁰⁹, 10⁻²¹⁰, 10⁻²¹¹, 10⁻²¹², 10⁻²¹³, 10⁻²¹⁴, 10⁻²¹⁵, 10⁻²¹⁶, 10⁻²¹⁷, 10⁻²¹⁸, 10⁻²¹⁹, 10⁻²²⁰, 10⁻²²¹, 10⁻²²², 10⁻²²³, 10⁻²²⁴, 10⁻²²⁵, 10⁻²²⁶, 10⁻²²⁷, 10⁻²²⁸, 10⁻²²⁹, 10⁻²³⁰, 10⁻²³¹, 10⁻²³², 10⁻²³³, 10⁻²³⁴, 10⁻²³⁵, 10⁻²³⁶, 10⁻²³⁷, 10⁻²³⁸, 10⁻²³⁹, 10⁻²⁴⁰, 10⁻²⁴¹, 10⁻²⁴², 10⁻²⁴³, 10⁻²⁴⁴, 10⁻²⁴⁵, 10⁻²⁴⁶, 10⁻²⁴⁷, 10⁻²⁴⁸, 10⁻²⁴⁹, 10⁻²⁵⁰, 10⁻²⁵¹, 10⁻²⁵², 10⁻²⁵³, 10⁻²⁵⁴, 10⁻²⁵⁵, 10⁻²⁵⁶, 10⁻²⁵⁷, 10⁻²⁵⁸, 10⁻²⁵⁹, 10⁻²⁶⁰, 10⁻²⁶¹, 10⁻²⁶², 10⁻²⁶³, 10⁻²⁶⁴, 10⁻²⁶⁵, 10⁻²⁶⁶, 10⁻²⁶⁷, 10⁻²⁶⁸, 10⁻²⁶⁹, 10⁻²⁷⁰, 10⁻²⁷¹, 10⁻²⁷², 10⁻²⁷³, 10⁻²⁷⁴, 10⁻²⁷⁵, 10⁻²⁷⁶, 10⁻²⁷⁷, 10⁻²⁷⁸, 10⁻²⁷⁹, 10⁻²⁸⁰, 10⁻²⁸¹, 10⁻²⁸², 10⁻²⁸³, 10⁻²⁸⁴, 10⁻²⁸⁵, 10⁻²⁸⁶, 10⁻²⁸⁷, 10⁻²⁸⁸, 10⁻²⁸⁹, 10⁻²⁹⁰, 10⁻²⁹¹, 10⁻²⁹², 10⁻²⁹³, 10⁻²⁹⁴, 10⁻²⁹⁵, 10⁻²⁹⁶, 10⁻²⁹⁷, 10⁻²⁹⁸, 10⁻²⁹⁹, 10⁻³⁰⁰, 10⁻³⁰¹, 10⁻³⁰², 10⁻³⁰³, 10⁻³⁰⁴, 10⁻³⁰⁵, 10⁻³⁰⁶, 10⁻³⁰⁷, 10⁻³⁰⁸, 10⁻³⁰⁹, 10⁻³¹⁰, 10⁻³¹¹, 10⁻³¹², 10⁻³¹³, 10⁻³¹⁴, 10⁻³¹⁵, 10⁻³¹⁶, 10⁻³¹⁷, 10⁻³¹⁸, 10⁻³¹⁹, 10⁻³²⁰, 10⁻³²¹, 10⁻³²², 10⁻³²³, 10⁻³²⁴, 10⁻³²⁵, 10⁻³²⁶, 10⁻³²⁷, 10⁻³²⁸, 10⁻³²⁹, 10⁻³³⁰, 10⁻³³¹, 10⁻³³², 10⁻³³³, 10⁻³³⁴, 10⁻³³⁵, 10⁻³³⁶, 10⁻³³⁷, 10⁻³³⁸, 10⁻³³⁹, 10⁻³⁴⁰, 10⁻³⁴¹, 10⁻³

Fig. 1

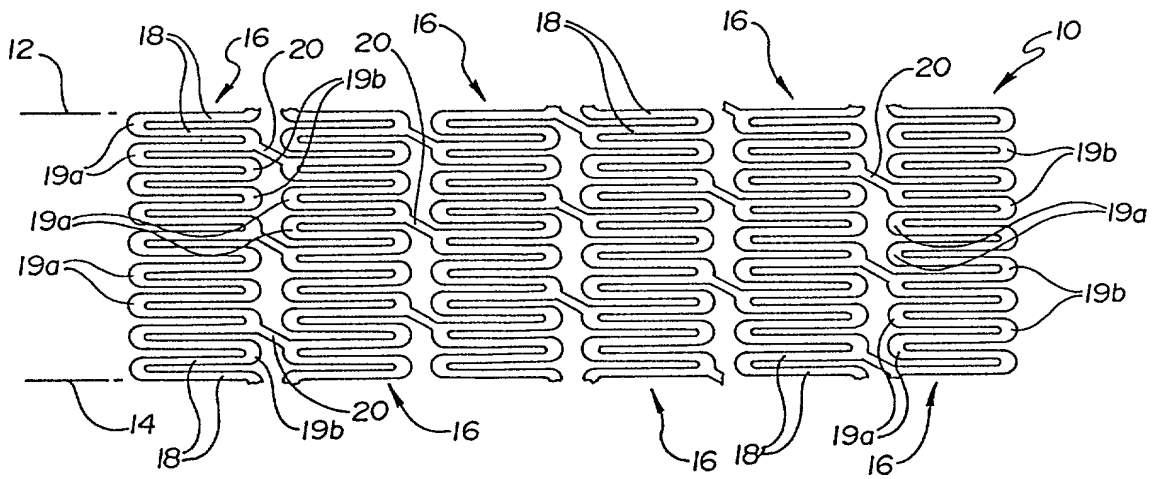
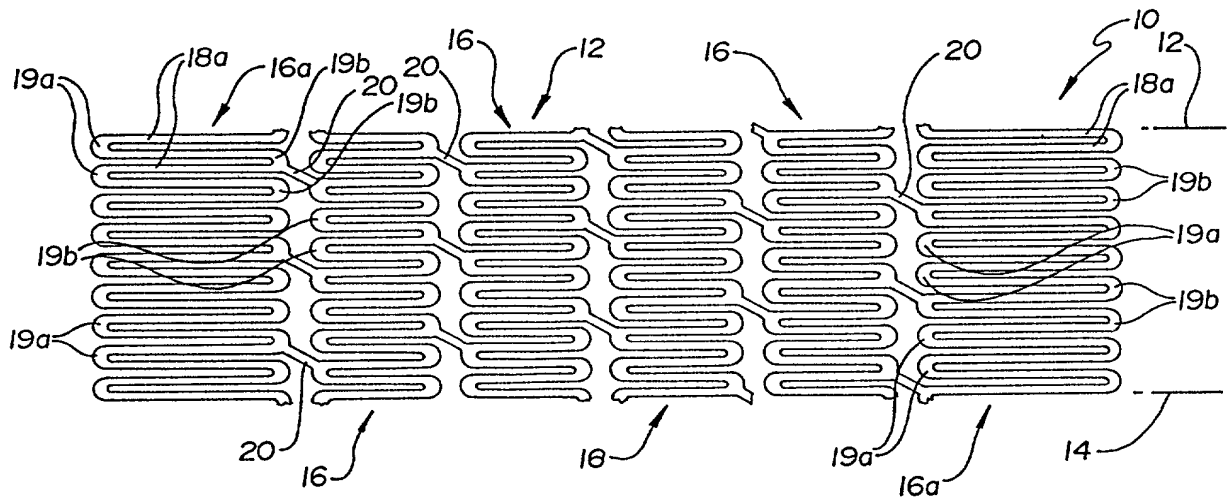


Fig. 4



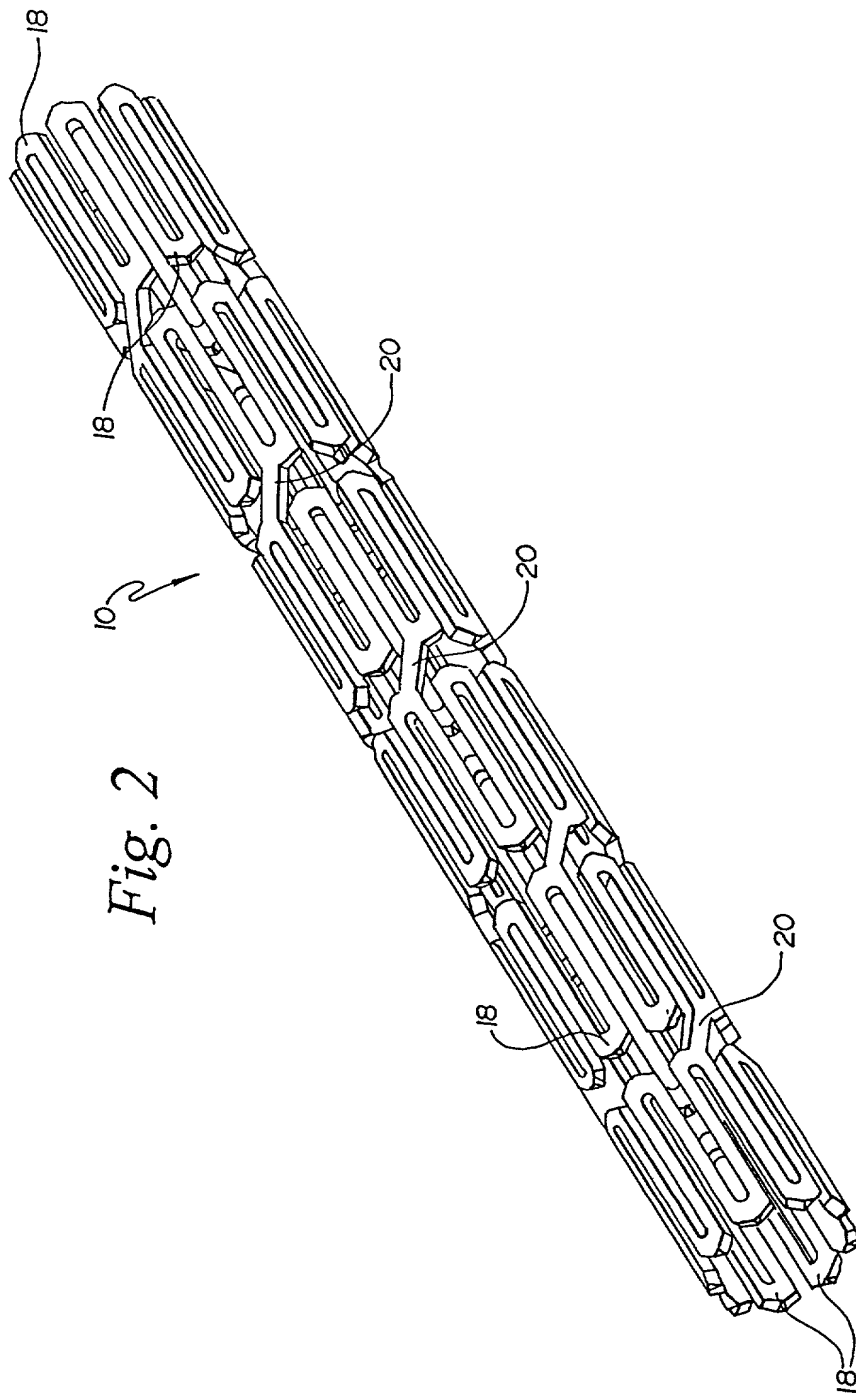


Fig. 2

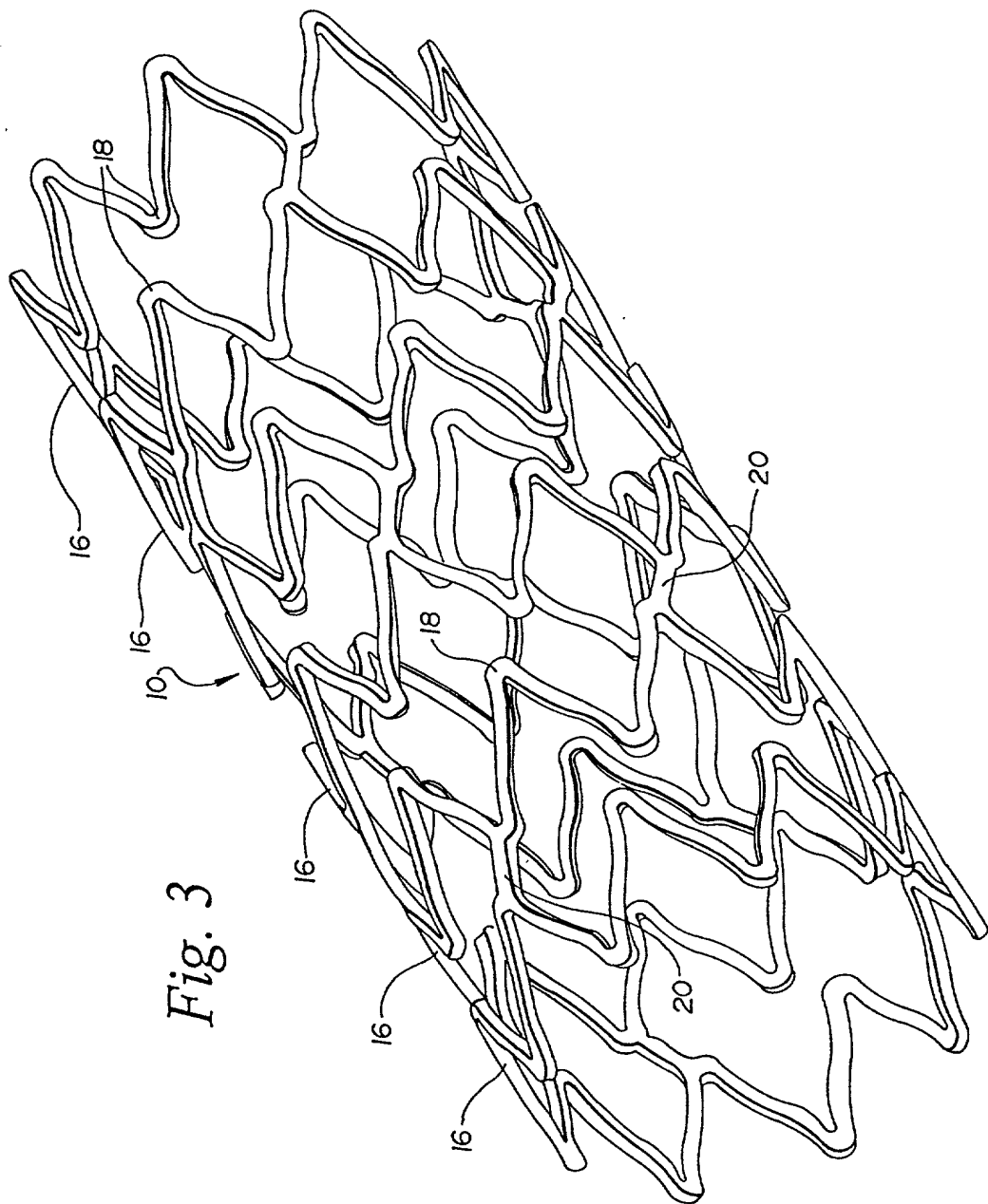


Fig. 3

DECLARATION

As a below-named inventor, I(we) hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type:

- ☐ original
- ☐ design
- ☐ supplemental
- ☐ national stage of PCT
- ☐ divisional
- ☒ continuation
- ☐ continuation-in-part (CIP)

INVENTORSHIP DECLARATION

My residence, post office address, and citizenship are as stated below next to my name;

I verily believe I am the original, first and sole inventor (*if only one name is listed below*) or an original, first and joint inventor (*if plural names are listed below*) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

IMPROVED LONGITUDINALLY FLEXIBLE EXPANDABLE STENT

the specification of which:

- a) ☐ is being filed concurrently herewith
- b) ☒ was filed on July 24, 1998 and assigned Serial No. 09/122,431
- c) ☐ was filed as PCT International Application No. _____ filed on _____ and amended under PCT Article 19 on _____.

ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations §1.56 including information occurring between the filing date of any prior application of which the present application is a continuation-in-part.

- ☐ In compliance with this duty there is attached an Information Disclosure Statement. 37 CFR 1.97.

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d), of any foreign application(s) for patent or inventor's certificate or of any PCT international applications(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application for patent or inventor's certificate or any PCT international applications(s) designating at least one country other than the United States of America filed by me having the same subject matter having a filing date before that of the application on which priority is claimed.

- a) ☒ no such applications have been filed.
b) ☐ such applications have been filed as follows:

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

I hereby claim the benefit under Title 35 United States Code, §119(e) of any United States provisional application identified below.

- a) ☐ no such applications have been filed.
b) ☒ such applications have been filed as follows:

U.S. APPLICATIONS	
APPLICATION NUMBER	U.S. FILING DATE
1.	
2.	

CLAIM FOR BENEFIT OF EARLIER U.S./PCT APPLICATIONS(S) UNDER 35 U.S.C. §120

I hereby claim the benefit under Title 35, United States Code, §120 of any United States applications(s) or PCT international applications(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior applications(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior applications(s) and the national or PCT international filing date of this application.

- a) ☐ no such applications have been filed.
b) ☒ such applications have been filed as follows:

U.S. APPLICATIONS	
SERIAL NUMBER	U.S. FILING DATE
1. 08/396,569	March 1, 1995
2. 08/511,076	August 3, 1995
PCT APPLICATIONS DESIGNATING THE U.S.	
PCT APPLICATION NO.	PCT FILING DATE
3.	

UTILITY/DESIGN PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Brian J. Brown et al.
Title:	IMPROVED LONGITUDINALLY FLEXIBLE EXPANDABLE STENT
Filed:	<input type="checkbox"/> concurrently herewith <input checked="" type="checkbox"/> on <u>July 24, 1998</u> and assigned Serial No. <u>09/122,431</u>

Assistant Commissioner for Patents
Washington, DC 20231

Docket No: S63.2-7076

POWER OF ATTORNEY FROM ASSIGNEE

As assignee of record of the entire interest of the above identified patent application,
SCIMED LIFE SYSTEMS, INC. hereby appoints the following attorneys to prosecute this application and to
transact all business in the Patent and Trademark Office connected therewith:

Jonathan Grad	Reg. No. 41,795
Oliver F. Arrett	Reg. No. 22,117
Scott Q. Vidas	Reg. No. 30,812
Walter J. Steinkraus	Reg. No. 29,592
Richard A. Arrett	Reg. No. 33,153
Robert O. Vidas	Reg. No. 20,164
Leonjeda M. Brennan	Reg. No. 35,332
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all of Vidas, Arrett & Steinkraus, P.A., Suite 2000, 6109 Blue Circle Drive, Minnetonka, MN 55343-9131,
Telephone: (612) 563-3000, Facsimile: (612) 563-3001, and hereby authorizes them to act and rely on
instructions from, and to communicate directly with, the firm or person which sent this case to Vidas, Arrett &
Steinkraus, P.A., unless or until it instructs Vidas, Arrett & Steinkraus P.A., in writing to the contrary.

Dated this 26th day of October, 1998.

(Company Name)

SCIMED LIFE SYSTEMS, INC.

(Signature)

By: 

(Typed name)

(Title)

Its: Patent Attorney

000260 95633001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Brown et al.
Application No.:	(Not yet assigned)
Filed:	(Concurrently herewith)
For:	IMPROVED LONGITUDINALLY FLEXIBLE EXPANDABLE STENT
Examiner:	(Not yet assigned)
Group Art Unit:	(Not yet assigned)

Box Patent Application
Commissioner for Patents
Washington, D.C. 20231

Docket No.: S63.2-9397

CORRESPONDENCE ADDRESS OF LAW FIRM

Vidas, Arrett & Steinkraus P.A. would like to make the following correspondence address of record. Please send all correspondence for this application to the address as follows:

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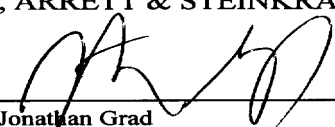
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Respectfully submitted,

VIDAS, ARRETT & STEINKRAUS

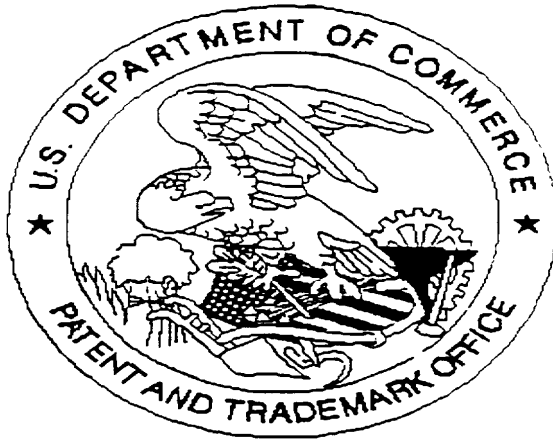
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